



United States Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine



Importation of Chinese Penjing
into the United States
With Particular Reference to *Sageretia thea*
2003 Supplementary Assessment

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Executive Summary

This pathway-initiated commodity risk assessment examines the risks associated with the proposed importation of penjing plants of *Sageretia thea*, in approved growing media, from the People's Republic of China into the United States. The quarantine pests that are likely to follow the pathway are analyzed using the methodology described in the USDA, APHIS, PPQ Guidelines 5.02 which examines pest biology in the context of the Consequences of Introduction and the Likelihood of Introduction and estimates the Pest Risk Potential. The quarantine pests that can potentially follow the pathway on these plants include one arthropod, two mollusks, two fungi and three nematodes.

The Pest Risk Potential for a root attacking mealybug (*Rhizoecus hibisci*) and mollusk pests is High, and the Pest Risk Potential for the fungal and nematode pathogens as well as the thrips (*Thrips palmi*) is Medium. Pests with a Low Pest Risk Potential typically do not require mitigation measures other than port of arrival inspection. Specific phytosanitary measures may be necessary for pests rated Medium, and specific phytosanitary measures are strongly recommended for pests with a High Pest Risk Potential.

Pest	Pest Risk Potential
ARTHROPODA <i>Rhizoecus hibisci</i> Kawai & Takagi (Homoptera: Pseudococcidae) <i>Thrips palmi</i> Karny (Thysanoptera: Thripidae)	High (29) Medium (26)
MOLLUSCA <i>Acusta ravida</i> (Benson) (Bradybaenidae) <i>Succinea horticola</i> Reinhart (Succineidae)	High (31) High (31)
FUNGI <i>Aecidium sageretiae</i> P. Henn. (Basidiomycetes, Uredinales) <i>Leptosphaeria</i> sp. (Loculoascomycetes, Dothideales)	Medium (23) Medium (25)
NEMATODA <i>Xiphinema brasiliense</i> Lordello (Xiphinematidae) <i>Tylenchorhynchus crassicaudatus</i> Williams (Belonolaimidae) <i>Tylenchorhynchus leviterminalis</i> Siddiqi, Mukherjee & Dasgupta (Belonolaimidae)	Medium (25) Medium (26) Medium (26)

In this document, a number of exotic, polyphagous pests intercepted in Europe on unspecified Abonsai® plants are assumed to be potential pests of *Sageretia* (EPPO, 1996a, b). The following pests, analyzed in 1996 using the PPQ Guidelines, version 4.0 criteria and then current literature are now not considered likely to follow the pathway of the importation based on a reexamination of their reported host ranges: *Acanthopsyche* sp., *Adoretus sinicus*, *Agrotis segetum*, *Amphimallon solstitialis*, *Anomala corpulenta*, *A. cupripes*, *Aphis gossypii*, *Aporia crataegi*, *Chrysodeixis chalcites*, *Conogethes punctiferalis*, *Drosicha corpulenta*, *Gryllotalpa orientalis*, *Helicoverpa armigera*, *H. assulta*, *Icerya aegyptica*, *Mamestra brassicae*, *Phyllophaga titanis*, *Pseudaulacaspis pentagona*, *Spodoptera litura*, *Sympiezomias velatus*, and *Tridactylus japonicus* (China, 1995). Similarly, pests

with limited US distribution (*Acalitus sageretiae*, *Bryobia latisetae*, *Cnidocampa flavescens* and *Pseudaonidia trilobitiformis*) are not analyzed.

The accompanying pest risk management document considers the reduction of risk that will occur when existing regulations on the importation of plants in APHIS-approved growing media (7 CFR ' 319.37-8) and proposed additional mitigation measures are applied to the importation of *Sageretia thea* penjing plants in growing media from the People's Republic of China. The safeguards will effectively remove the pests of concern from the pathway and allow the importation of these plants to be associated with no more pest risk than is associated with currently permitted bare-root importations.

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I. Introduction

This pest risk assessment (PRA) was conducted by the United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, Center for Plant Health Science and Technology, Plant Epidemiology and Risk Analysis Laboratory (USDA, APHIS, PPQ, CPHST, PERAL) to examine the plant pest risks associated with the importation of artificially dwarfed plants of *Sageretia thea* established in an APHIS-approved growing medium from the People's Republic of China into the United States. The purpose of this document is to update an earlier version (Cave and Redlin, 1996).

The art of artificially dwarfing plants is a time-consuming and highly labor-intensive activity. The resulting plants range from approximately four inches to 60 inches in height, and the value may range from \$10 to \$10,000 per plant. The median price of an artificially dwarfed plant is close to \$100 and varies with the age of the plant regardless of size. Plants imported from Asia (Japan, the People's Republic of China and the Republic of Korea) represent approximately 80 percent of the value of the entire artificially dwarfed plant market in the United States (Importation of Artificially Dwarfed Plants in Growing Media From the People's Republic of China, 65 Fed. Reg. 56803-56806 (2000) (as proposed Sept. 20, 2000) (Docket Number: 98-103-1)).

Authority for APHIS to regulate plant pests and plant products is derived from the Plant Protection Act of 2000 (7 USC ' ' 7701 *et seq.*) and the Code of Federal Regulations, Title 7, Part 319, Subpart 37 (7 CFR ' ' 319.37 - Nursery Stock, Plants, Roots, Bulbs, Seeds and Other Plant Products). The risk assessment methodology and rating criteria and the use of biological and phytosanitary terms is consistent with international guidelines (FAO, 2001, 2002; NAPPO, 1995) and current agency guidelines (APHIS, 2000).

II. Risk Assessment

A. Initiating Event: Proposed Action

This commodity-based, pathway-initiated pest risk assessment is prepared in response to a request from the Chinese Animal and Plant Quarantine Service (ASIQ) to change current regulations to allow increased types of importations of artificially dwarfed penjing plants of *Sageretia thea*, in APHIS-approved growing media, from China into the United States. This is a potential pathway for the introduction of plant pests. The entry of bare-root *S. thea* from China into the United States is currently regulated under 7 CFR ' ' 319.37, and does not explicitly prohibit the importation of naturally dwarf plants under 305 millimeters in length or artificially dwarfed plants. This lack of restrictions allows such plants to enter the United States if the plants are accompanied by a phytosanitary certificate of inspection.

The USDA carefully assesses requests to change regulations related to propagative materials because the importation of propagative material in growing media raises unique phytosanitary concerns. Specifically, biological contaminants may not be discernible during pre-shipment and Port of Entry visual inspections. This inability to non-destructively inspect may increase the potential for the introduction of

exotic organisms. Treatment of growing media may not rid the media of organisms in the absence of specific guidelines, and the possibility of pest infestation/re-infestation of clean plants in the absence of specific safeguards exists.

During the past decade, China exported significant volumes of bare-root bonsai plants into the United States under the existing regulations. In August 1992, representatives of the China Animal and Plant Quarantine Service (ASIQ) requested permission to export penjing plants established in APHIS-approved growing media. A list of 112 plant species was submitted. These plants were categorized by PPQ as Prohibited, Post-entry quarantine, and Restricted. In January 1994, ASIQ was asked to select five species for pest risk analysis. Subsequently, ASIQ submitted a list of eight species, and provided a list of pests or potential pests associated with these plants. In April 1994, PPQ staff identified five plant species as candidates for pest risk assessments: *Buxus sinica* (Buxaceae), *Ehretia* (*Carmona*) *microphylla* (Boraginaceae), *Podocarpus macrophyllus* (Podocarpaceae), *Sageretia thea* (*theazans*) (Rhamnaceae), and *Serissa foetida* (Rubiaceae). The risk assessment for *S. thea* was completed in September 1996 using agency guidelines 4.0 (APHIS, 1995). A Proposed Rule was published in 65 Fed. Reg 183 (Docket Number 00-042-1) on September 20, 2000. Compliance with the Endangered Species Act necessitated PPQ consultation with the US Fish and Wildlife Service (USFWS). Additional documentation was provided separately to the USFWS. These documentary requirements created a need to re-examine and update the original risk assessment for *S. thea*.

The updates to address public comments and from consultations with USFWS led to a re-examination of the original risk assessment for *S. thea*. The current analysis on the host ranges of a number of exotic, polyphagous insects analyzed in the 1996 document, shows that these pests are not likely to follow the pathway of this importation. The following pests are generalist feeders that were not listed as present on *Sageretia* in Chinese penjing gardens (China, 1995): *Acanthopsyche* sp., *Adoretus sinicus*, *Agrotis segetum*, *Amphimallon solstitialis*, *Anomala corpulenta*, *A. cupripes*, *Aphis gossypii*, *Aporia crataegi*, *Chrysodeixis chalcites*, *Conogethes punctiferalis*, *Drosicha corpulenta*, *Gryllotalpa orientalis*, *Helicoverpa armigera*, *H. assulta*, *Icerya aegyptica*, *Mamestra brassicae*, *Phyllophaga titanis*, *Pseudaule caspis pentagona*, *Spodoptera litura*, *Sympiezomias velatus*, and *Tridactylus japonicus* (China, 1995). Published biological evidence validates the information supplied by the Chinese government that *Sageretia* is not a host of these pests so they are not analyzed in this document as posing a phytosanitary risk.

The artificially dwarfed plants proposed for export are in the plant family, Rhamnaceae. This family has approximately 19 genera including: *Ceanothus*, *Colubrina*, *Condalia*, *Rhamnus* and *Ziziphus* (NRCS, 2003). Worldwide, there are 10 to 20 species recognized within the genus *Sageretia* (Nesom, 1993). In the United States, there are three species (NatureServe, 2003). In addition to *S. thea*, the US native perennials are *S. minutiflora* (Michx.) Mohr in Alabama, Florida, Georgia (on State Threatened list), Mississippi, North Carolina and South Carolina, and *S. wrightii* Wats. in Arizona, New Mexico and Texas (NRCS, 2003; NatureServe, 2003). Variants on the older specific epithet *theazans* (such as *theezans* and *thezans*) are used for *S. thea* in commercial trade (Bonsai Brasil, 1999; Caine, 2003;

PGBC, 1997;). The *S. thea* plants can grow ~~A~~prodigiously indoors (PGBC, 1997), and are routinely placed outdoors once nighttime temperatures are consistently above 55 degrees Fahrenheit (Caine, 2003).

The volume of artificially dwarfed and other dwarf plants imported into the United States increased in recent years from fewer than 600 plants in 1993 to over 54,000 plants in 1998 [Importation of Artificially Dwarfed Plants in Growing Media From the People's Republic of China, 65 Fed. Reg. 56803-56806 (2000) (Docket Number: 98-103-1)]. The Final Rule was designed to reduce the risks associated with field-collected plants that are produced quickly in their country of origin for mass export [Importation of Artificially Dwarfed Plants 67 Fed. Reg. 53727-53731 (2002) (Docket No. 00-042-2)]. These field-grown plants include species that, historically, were not imported as artificially dwarfed plants and that may not be given the same meticulous care and safeguards as traditionally produced penjing plants. The rule also requires that the plants are grown for at least two years in a greenhouse or screen-house in approved nurseries that are inspected annually, and that phytosanitary certificates accompany the plants. Artificially dwarfed plants grown in fields prior to their 2-year greenhouse/screen-house growth period are required to be produced with specific safeguards to protect against infestation by longhorned beetles (Coleoptera: Cerambycidae).

B. Assessment of the Weed Potential of *Sageretia thea*

If the species considered for import poses a risk as a weed pest, then a “pest-initiated” risk assessment is conducted. This screening of *S. thea* did not prompt a pest-initiated risk assessment because the evaluation concluded that there is not a significant weed potential. Although not native to the United States, *S. thea* is frequently grown in indoor habitats and are not regularly grown outdoors in unmanaged habitats (NatureServe, 2003; NRCS, 2003; PGBC, 1997) (Table 1).

Table 1. Weed Potential of <i>Sageretia thea</i>	
Commodity: <i>Sageretia thea</i> (Osbeck) Johnston (Rhamnaceae) Synonym: <i>Sageretia theazans</i>	
Phase 1: The genus <i>Sageretia</i> has only three species in the United States, and they occur primarily in the Southern tier of the country (NatureServe, 2003; NRCS, 2003).	
Phase 2: Is the genus listed in:	
<u>NO</u>	Geographical Atlas of World Weeds (Holm <i>et al.</i> , 1979)
<u>NO</u>	World's Worst Weeds (Holm <i>et al.</i> , 1977) or World Weeds: Natural Histories and Distribution (Holm <i>et al.</i> , 1997)
<u>NO</u>	Report of the Technical Committee to Evaluate Noxious Weeds; Exotic Weeds for Federal Noxious Weed Act (Gunn and Ritchie, 1982)
<u>NO</u>	Economically Important Foreign Weeds (Reed, 1977)
<u>NO</u>	Weed Science Society of America list (WSSA, 1989)
<u>NO</u>	Is there any literature reference indicating weed potential, <i>e.g.</i> AGRICOLA, CAB Biological Abstracts, AGRIS; search on " <i>Sageretia</i> " combined with "weed".

Phase 3: *Sageretia thea* is not reported as a weed and is commonly cultivated in interiorscapes throughout the United States.

C. Prior Risk Assessments, Current Status and Pest Interceptions

Currently, artificially dwarfed plants of *Sageretia* species may be imported as bare-root plants (7 CFR ' 319.37). The risk assessment for *S. thea* in growing media was completed in September 1996. Endangered species concerns necessitated consultations with the U.S. Fish and Wildlife Service. Additional mitigation measures applicable to artificially dwarfed plants in growing media were promulgated in a Final Rule (67 Fed. Reg. 53727-53731 on April 19, 2002) developed in response to interceptions of beetles. All mitigation measures in 67 Fed. Reg. 53727-53731 (2002) apply to *S. thea* plants. Interceptions of pests on bare-root *Sageretia thea* are summarized in Table 2.

Table 2. Pest interceptions on bare-root <i>Sageretia thea</i> from China from 1985 to 2003. All interceptions occurred once in the indicated year unless otherwise noted.		
Pest	Dates	Location
Aphididae	1995	general cargo
<i>Ascochyta</i> sp.	1993	permit cargo
<i>Autosticha</i> sp.	1992	general cargo
<i>Bradybaena</i> sp.	1997	permit cargo
Cecidomyiidae	1987	permit cargo
<i>Dasineura</i> sp.	1987	permit cargo
<i>Dialeurodes</i> sp.	2001	permit cargo
Diaspididae	1991, 1994	general cargo
<i>Diatrypella</i> sp.	1991	permit cargo
<i>Kleidocerys</i> sp.	1991	permit cargo
<i>Leptosphaeria</i> sp.	1998	permit cargo
<i>Pestalotiopsis</i> sp.	1990	permit cargo
Phlaeothripidae	1996	permit cargo
<i>Phomopsis</i> sp.	1993, 1996	general cargo, permit cargo
<i>Rhizoecus</i> sp.	1994	passenger baggage
Scolytidae	2000	permit cargo
Siricidae	1998	permit cargo
Sminthuridae	1991	general cargo
<i>Succinea horticola</i>	1994	passenger baggage
<i>Succinea</i> sp.	2003	permit cargo
<i>Tarsonemus</i> sp.	1996	permit cargo

D. Pest Categorization

The pests associated with *S. thea* in China are listed in Table 3. This list identifies: (1) the presence or absence of these pests in the United States, (2) the generally affected plant part or parts, (3) any additionally important hosts, (4) the quarantine status of the pest with respect to the United States, (5) whether the pest is likely to follow the pathway to enter the United States, and (6) pertinent citations for either the distribution or the biology of the pest. Because of specific characteristics of a given pest's biology and distribution, many organisms are eliminated from further consideration as sources of phytosanitary risk because they do not satisfy the FAO definition of a quarantine pest (FAO, 2002).

Only those quarantine pests that are likely to follow the pathway are further analyzed. A quarantine pest is, "A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled" (FAO, 2002). Pests not of potential economic importance, lacking the distribution requirements, or not under official control cannot be analyzed beyond listing in Table 3 because they do not meet internationally agreed criteria (FAO, 2001). For this same reason, organisms that are not agents injurious to plants (FAO, 2002) cannot be analyzed for phytosanitary concern.

Some of the quarantine pests listed in Table 3 may be potentially detrimental to the agricultural systems of the United States. There are a variety of reasons for not subjecting them to further analysis. Examples include, but are not limited to the following: non-fertile life stages can be transported in a shipment but are unable to establish viable populations upon entry into the United States, pests can become associated with the commodity because of packing or handling procedures (biological contaminants), or the pests may be associated with the commodity but will not remain with it during transport or processing. Insects with inherent mobility (wings, legs, etc.) and/or the instinct to avoid light or human activity will not remain with the commodity. In contrast, quarantine pests that are unable to leave the commodity may have immobile or cryptic life stages and can follow the pathway.

Table 3. Pests Associated with <i>Sageretia thea</i> in China.						
Pest	Geographic Distribution ¹	Additional Host Genera ²	Plant Part Affected ³	Quarantine Pest	Follow Pathway	References
ACARI						
Eriophyidae						
<i>Acalitus sageretiae</i> Kuangis	CN, US (FL) ¹	No additional hosts	Leaf	No ¹	Yes	China, 1994; 1995; Hong and Zhang, 1996; Welbourn, 2000
Tarsonemidae						
<i>Tarsonemus</i> sp.	CN, US	Various	Unknown	Yes	Yes	PIN 309, 2003

Table 3. Pests Associated with <i>Sageretia thea</i> in China.						
Pest	Geographic Distribution ¹	Additional Host Genera ²	Plant Part Affected ³	Quarantine Pest	Follow Pathway	References
Tetranychidae						
<i>Bryobia latisetae</i> Wang	CN, US (FL) ¹	<i>Leptodermis</i>	Leaf	No ¹	Yes	Bolland <i>et al.</i> , 1998; Welbourn, 2000
ARTHROPODA						
COLEOPTERA						
Curculionidae						
<i>Sympiezomias velatus</i> Chevrolat ⁴	CN	Polyphagous	Whole plant	Yes	No ⁴	China, 1995
Scarabaeidae						
<i>Adoretus sinicus</i> (Burmeister) ⁴	CN, US (HI)	Polyphagous	Root	Yes	No ⁴	7 CFR 318.13; China, 1995; INKTO #89
<i>Amphimallon solstitialis</i> (L.) ⁴	CN	Polyphagous	Leaf, Root	Yes	No ⁴	Browne, 1968; China, 1995; CIE, 1979; INKTO #99
<i>Anomala corpulenta</i> Motschulsky ⁴	CN	Polyphagous	Leaf, Root	Yes	No ⁴	China, 1994; 1995
<i>Anomala cupripes</i> Hope ⁴	CN	Polyphagous	Leaf, Root	Yes	No ⁴	China, 1994; 1995; Gordon, 1994
<i>Phyllophaga</i> sp.	CN, US	Polyphagous	Leaf, Root	Yes	Yes	China, 1995
<i>Phyllophaga titanis</i> Reitter ⁴	CN	Polyphagous	Leaf, Root	Yes	No ⁴	China, 1994; 1995; Gordon, 1994
Scolytidae						
Scolytidae sp.	CN, US	Polyphagous	Root	Yes	Yes	PIN 309, 2003
COLLEMBOLA						
Sminthuridae						
Sminthuridae sp.	CN, US	Various	Leaf, Soil	Yes	Yes	PIN 309, 2003
DIPTERA						
Cecidomyiidae						
Cecidomyiidae sp.	CN, US	Various	Leaf	Yes	Yes	PIN 309, 2003
<i>Dasineura</i> sp.	CN, US	Various	Leaf	Yes	Yes	PIN 309, 2003
HETEROPTERA						
Lygaeidae						
<i>Kleidocerys</i> sp.	CN, US	Various	Leaf, Stem	Yes	Yes	PIN 309, 2003
HOMOPTERA						
Aleyrodidae						
<i>Dialeurodes</i> sp.	CN, US	Various	Leaf	Yes	Yes	PIN 309, 2003
Aphididae						
Aphididae sp.	CN, US	Various	Leaf, Stem	Yes	Yes	PIN 309, 2003

Table 3. Pests Associated with <i>Sageretia thea</i> in China.						
Pest	Geographic Distribution ¹	Additional Host Genera ²	Plant Part Affected ³	Quarantine Pest	Follow Pathway	References
<i>Aphis gossypii</i> Glover	CN, US	Polyphagous	Leaf, Stem	No	Yes	China, 1995; CIE, 1968; Patch, 1938; Smith and Parron, 1978; Wilson and Vickery, 1981
Coccidae						
<i>Coccus hesperidum</i> Linnaeus	CN, US	Polyphagous	Leaf, Stem	No	Yes	Scalenet, 2003
Coccidae sp.	CN, US	Various	Fruit, Leaf, Stem	Yes	Yes	China, 1994
Diaspididae						
<i>Aonidiella taxus</i> Leonardi	CN, US	<i>Cephalotaxus</i> , <i>Taxus</i>	Leaf, Stem	No	Yes	China, 1994; Dekle, 1965; EPPO, 1996b; Nakahara, 1982; Qin <i>et al.</i> , 1997; Uematsu, 1978
Diaspididae sp.	CN	Various	Fruit, Leaf, Stem	Yes	Yes	China, 1994; PIN 309, 2003
<i>Pseudaonidia trilobitiformis</i> (Green)	CN, US (FL) ¹	Polyphagous	Leaf, Stem	No ¹	Yes	China, 1994; CIE, 1981; Nakahara, 1982
<i>Pseudaulacaspis pentagona</i> (Targioni Tozzetti)	CN, US	Polyphagous	Fruit, Leaf, Stem	No	Yes	China, 1994; China, 1995; Dekle, 1965; Nakahara, 1982
Margarodidae						
<i>Drosicha corpulenta</i> (Kuwana) ⁴	CN	Polyphagous	Root, Stem	Yes	No ⁴	China, 1995; Shiraki, 1952
Pseudococcidae						
Pseudococcidae sp.	CN, US	Various	Leaf, Root, Stem	Yes	Yes	China, 1994; 1995
<i>Rhizoecus hibisci</i> Kawai and Takagi	CN, US (HI) ¹	Polyphagous	Leaf, Root, Stem	No ¹	Yes	EPPO, 1996a
<i>Rhizoecus</i> sp.	CN, US	Various	Leaf	Yes	Yes	PIN 309, 2003
<i>Icerya aegyptica</i> (Douglas) ⁴	CN	Polyphagous	Leaf, Stem	Yes	No ⁴	China, 1995; CIE, 1966b; INKTO #119; Williams, 1985
HYMENOPTERA						
Eurytomidae						
<i>Cnidocampa flavescens</i> (Walker)	CN, US (MA, PA, PR) ¹	Polyphagous	Leaf	No ¹	Yes	EPPO, 1996b; Shiraki, 1952; Zhang, 1994
Siricidae						

Table 3. Pests Associated with <i>Sageretia thea</i> in China.						
Pest	Geographic Distribution ¹	Additional Host Genera ²	Plant Part Affected ³	Quarantine Pest	Follow Pathway	References
Siricidae sp.	CN, US	Various	Stem	Yes	Yes	PIN 309, 2003
LEPIDOPTERA						
Noctuidae						
<i>Agrotis segetum</i> (Denis & Schiffermuller) ⁴	CN	Polyphagous	Leaf, Root, Stem	Yes	No ⁴	Carter, 1984; China, 1995; INKTO #25
<i>Chrysodeixis chalcites</i> (Esper) ⁴	CN	Polyphagous	Fruit, Inflor., Leaf, Stem	Yes	No ⁴	China, 1995; CIE, 1977; Goodey, 1991; Taylor, 1980
<i>Helicoverpa armigera</i> (Hübner) ⁴	CN	Polyphagous	Fruit, Inflor., Leaf, Stem	Yes	No ⁴	Avidov and Harpaz, 1969; China, 1995; CIE, 1993a
<i>Helicoverpa assulta</i> (Guenée) ⁴	CN	Polyphagous	Fruit, Inflor., Leaf, Stem	Yes	No ⁴	China, 1995; CIE, 1994
<i>Mamestra brassicae</i> (L.) ⁴	CN	Polyphagous	Fruit, Inflor., Leaf, Stem	Yes	No ⁴	China, 1995; INKTO #61
<i>Spodoptera litura</i> (F.) ⁴	CN	Polyphagous	Leaf, Root	Yes	No ⁴	China, 1995; CIE, 1993b; INKTO #12
Oecophoridae						
<i>Autosticha</i> sp.	CN,US	Various	Leaf	Yes	Yes	PIN 309, 2003
Pieridae						
<i>Aporia crataegi</i> L. ⁴	CN	Polyphagous	Leaf	Yes	No ⁴	Anon., 1972; China, 1995; INKTO #149
Psychidae						
<i>Acanthopsyche</i> sp. ⁴	CN	Polyphagous	Leaf	No	No ⁴	China, 1994; 1995
Pyralidae						
<i>Conogethes punctiferalis</i> (Guenée) ⁴	CN	Polyphagous	Fruit, Leaf, Stem	Yes	No ⁴	China, 1995; INKTO #19
ORTHOPTERA						
Gryllotalpidae						
<i>Gryllotalpa orientalis</i> Burmeister (= <i>G. africana</i> Palisot de Beauvois) ⁴	CN, US (HI)	Polyphagous	Root	No	No ⁴	China, 1995; Hua, 2000; INKTO #197
Trydactilidae						
<i>Tridactylus japonicus</i> de Hoan ⁴	CN	Polyphagous	Root	Yes	No ⁴	China, 1994; 1995; Shiraki, 1952
THYSANOPTERA						
Phlaeothripidae						

Table 3. Pests Associated with <i>Sageretia thea</i> in China.						
Pest	Geographic Distribution ¹	Additional Host Genera ²	Plant Part Affected ³	Quarantine Pest	Follow Pathway	References
Phlaeothripidae sp.	CN, US	Various	Fruit, Inflor., Leaf, Stem	Yes	Yes	PIN 309, 2003
Thripidae						
<i>Thrips palmi</i> Karny	CN, US (American Samoa, FL, Guam, HI, PR)	Polyphagous	Inflor., Leaf, Stem	Yes	Yes	CIE, 1992; CPC, 2002; Martin and Mau, 1992; Nakahara, 1994; Payne, 2003; Smith <i>et al.</i> , 1992
FUNGI						
<i>Aecidium sageretiae</i> P. Henn. (Basidiomycetes, Uredinales)	CN	No additional hosts	Leaf	Yes	Yes	China, 1994; Farr <i>et al.</i> 1989; SBML, 2003; Tai, 1979
<i>Ascochyta</i> sp. (Fungi Imperfecti, Coelomycetes)	CN, US	Various	Leaf	Yes	Yes	PIN 309, 2003
Ascomycete sp.	CN, US	Various	Whole plant	Yes	Yes	China, 1994; 1995
<i>Dennisiella babingtonii</i> (Berk.) Batista & Cif. Ana: <i>Microxiphium fagi</i> (Pers.) S. J. Hughes (= <i>Capnodium footii</i> (Ascomycetes, Dothideales)	CN, US	<i>Buxus, Ehretia, Illicium</i>	Leaf	No	Yes	China 1994; Farr <i>et al.</i> , 1989
<i>Diatrypella</i> sp. (Ascomycetes, Diatrypales)	CN, US	Various	Stem	Yes	Yes	PIN 309, 2003
<i>Erysiphe</i> sp. (Ascomycetes, Erysiphales)	CN, US	Various	Fruit, Leaf, Stem, Soil	Yes	Yes	China, 1994
<i>Leptosphaeria</i> sp. (Ascomycetes, Dothideales)	CN, US	Various	Leaf, Stem	Yes	Yes	China, 1994; 1995; PIN 309, 2003
<i>Microsphaeropsis</i> sp. (Fungi Imperfecti, Coelomycetes)	CN, US	Various	Leaf	Yes	Yes	China, 1994
<i>Pestalotiopsis</i> sp. (Fungi Imperfecti, Coelomycetes)	CN, US	Various	Leaf	Yes	Yes	PIN 309, 2003
<i>Phoma</i> sp. (Fungi Imperfecti, Coelomycetes)	CN, US	Various	Leaf, Stem	Yes	Yes	China, 1994; 1995
<i>Phomopsis</i> sp. (Fungi Imperfecti, Coelomycetes)	CN, US	Various	Leaf, Stem	Yes	Yes	PIN 309, 2003
MOLLUSCA						
Bradybaenidae						

Table 3. Pests Associated with <i>Sageretia thea</i> in China.						
Pest	Geographic Distribution ¹	Additional Host Genera ²	Plant Part Affected ³	Quarantine Pest	Follow Pathway	References
<i>Bradybaena</i> sp.	CN, US	Polyphagous	Whole plant, Soil	Yes	Yes	PIN 309, 2003
<i>Acusta ravida</i> (Benson)	CN	Polyphagous	Whole plant, Soil	Yes	Yes	China, 1995; Likhachev and Rammelmeyer, 1962
<i>Bradybaena similis</i> (Ferussac)	CN, US	Polyphagous	Whole plant, Soil	No	Yes	Chang and Chen, 1989; China, 1994; Dundee, 1970; Yen, 1943
Succineidae						
<i>Succinea horticola</i> Reinhart	CN	Polyphagous	Whole plant, Soil	Yes	Yes	PIN 309, 2003
<i>Succinea</i> sp.	CN, US	Various	Whole plant, Soil	Yes	Yes	PIN 309, 2003
NEMATODA						
Aphelenchida						
<i>Aphelenchoides besseyi</i> Christie	CN, US	Polyphagous	Leaf, Root, Soil	No	Yes	Anon., 1984; EPPO, 1996a
<i>Aphelenchus</i> sp.	CN, US	Various	Root, Soil	Yes	Yes	EPPO, 1996a
Dorylaimida						
<i>Dorylaimidae</i> sp.	CN, US	Various	Root, Soil	Yes	Yes	EPPO, 1996a
<i>Dorylaimus</i> sp.	CN, US	Various	Root, Soil	Yes	Yes	EPPO, 1996b
<i>Xiphinema brasiliense</i> Lordello	CN ¹	Polyphagous	Root, Soil	Yes ¹	Yes	Anon., 1984; EPPO, 1996b
<i>Xiphinema</i> sp.	CN, US	Various	Root, Soil	Yes	Yes	EPPO, 1996a, b
Tylenchida						
<i>Criconebella</i> sp.	CN, US	Various	Root, Soil	Yes	Yes	EPPO, 1996a
<i>Helicotylenchus dihystra</i> (Cobb) Sher.	CN, US	Polyphagous	Root, Soil	No	Yes	Anon., 1984; EPPO, 1996a, b
<i>Helicotylenchus</i> sp.	CN, US	Various	Root, Soil	Yes	Yes	EPPO, 1996a, b
<i>Hirschmanniella</i> sp.	CN, US	Various	Root, Soil	Yes	Yes	EPPO, 1996a, b
<i>Meloidogyne</i> sp.	CN, US	Various	Root, Soil	Yes	Yes	EPPO, 1996b
<i>Paratrophurus</i> sp.	CN, US	Various	Root, Soil	Yes	Yes	EPPO, 1996a
<i>Pratylenchus brachyurus</i> (Godfrey) Filipjev & Schuurmans Stekhoven	CN, US	Polyphagous	Root, Soil	No	Yes	Anon., 1984; EPPO, 1996b
<i>Pratylenchus penetrans</i> (Cobb, 1917) Filipjev & Schuurmans Stekhoven	CN, US	Polyphagous	Root, Soil	No	Yes	China, 1994; USDA, 2003
<i>Pratylenchus</i> sp.	CN	Polyphagous	Root, Soil	Yes	Yes	EPPO, 1996a, b
<i>Rotylenchus robustus</i> (deMan) Filipjev	CN, US	Polyphagous	Root, Soil	No	Yes	EPPO, 1996b

Table 3. Pests Associated with <i>Sageretia thea</i> in China.						
Pest	Geographic Distribution ¹	Additional Host Genera ²	Plant Part Affected ³	Quarantine Pest	Follow Pathway	References
<i>Tylenchorhynchus</i> sp.	CN	Various	Root, Soil	Yes	Yes	EPPO, 1996a
<i>Tylenchorhynchus crassicaudatus</i> Williams	CN	<i>Musa</i> , <i>Oryza</i> , <i>Saccharum</i> , <i>Sorghum</i>	Root, Soil	Yes	Yes	EPPO, 1996a, b; Lin and Chiu, 1971; Rodriguez and Ayala, 1977; Williams, 1960
<i>Tylenchorhynchus leviterminalis</i> Siddiqi, Mukherjee & Dasgupta	CN	Polyphagous	Root, Soil	Yes	Yes	EPPO, 1996a, b
<i>Tylenchus</i> sp.	CN, US	Various	Root, Soil	Yes	Yes	EPPO, 1996a
Triplonchida						
<i>Trichodorus</i> sp.	CN, US	Various	Root, Soil	Yes	Yes	EPPO, 1996a

¹Geographic Distribution: CN - China, US - United States, FL - Florida, HI - Hawaii, MA - Massachusetts.

Individual states are listed only if the pest is reported in less than five States or US territories. The organisms with limited US distribution that are likely to follow the pathway are *Acalitus sageretiae*, *Bryobia latisetiae*, *Cnidocampa flavescens*, *Pseudaonidia trilobitiformis*, *Rhizococcus hibisci* and *Thrips palmi*. See textual discussion following Table 3. Lack of analysis in this document shall not be construed as any type of indicator on future agency policy for these pests.

²Polyphagous means the species feeds and reproduces on multiple hosts in multiple plant families. Various means different species use a variety of hosts. When species of *Sageretia* are the only hosts reported in the available literature, then “No additional hosts” is noted in the table.

³Plant Part Affected: Inflor. = inflorescence.

⁴The following pests are generalist feeders that were not listed as present on *Sageretia* in Chinese penjing gardens (China, 1995): The following pests are generalist feeders that were not listed as present on *Sageretia* in Chinese penjing gardens (China, 1995): *Acanthopsyche* sp., *Adoretus sinicus*, *Agrotis segetum*, *Amphimallon solstitialis*, *Anomala corpulenta*, *A. cupripes*, *Aphis gossypii*, *Aporia crataegi*, *Chrysodeixis chalcites*, *Conogethes punctiferalis*, *Drosicha corpulenta*, *Gryllotalpa orientalis*, *Helicoverpa armigera*, *H. assulta*, *Icerya aegyptica*, *Mamestra brassicae*, *Phyllophaga titanis*, *Pseudauleacaspis pentagona*, *Spodoptera litura*, *Sympiezomias velatus*, and *Tridactylus japonicus* (China, 1995). Published biological evidence validates the information supplied by the Chinese government that *Sageretia* is not a host of these pests. Published biological evidence validates the information supplied by the Chinese government that *Sageretia* is not a host of these pests. In 1996, some of these pests were assessed as following the pathway due to their generalist habits, but current information shows that these pest are not likely to follow the pathway of this importation.

The unknown taxonomic status associated with species of *ACalyptozele* was prompted by a submission of this species name by the ASIQ (China, 1995), which we could not subsequently substantiate as having a known equivalent in the scientific literature. Literature searches did not find any synonymy to other existing genera. We therefore excluded this ambiguous name from consideration in this analysis because it is not a known, valid species name.

The interceptions on penjing from China (EPPO, 1996a; b) do not explicitly link the host to the intercepted pest. Based on these reports, all the intercepted pests are ascribed to *Sageretia* in this document (Table 3). Although *Acalitus sageretiae*, *Bryobia latisetiae*, *Cnidocampa flavescens*, and

Pseudaonidia trilobitiformis have limited US distribution, they are not analyzed in this document because they are not under official control, and therefore, do not meet the definition of a quarantine pest (FAO, 2002). The nematode *Xiphinema brasiliense* was identified in Putnam County, Florida in 1959 (Lehman, 2002) and in California in 1974 (Hackney, 2003). The Society of Nematology personal communication reference to its presence in Florida may have been the same 1959 isolation (Anon., 1984; Handoo, 2003). There appear to be no other reports of *X. brasiliense* in the United States. For the purpose of this document, it is considered a quarantine pest because it was not identified in the United States in at least the last 25 years. *Thrips palmi* is analyzed because it is under consideration by USDA APHIS for official control (Payne, 2003). The biological information available for *Rhizoecus hibisci* is used to analyze *Rhizoecus* sp.

The biological hazard of organisms not identified to the species level was not directly assessed. In this risk assessment, this applies to: *Ascochyta* sp., Ascomycete, Aphididae, *Autosticha* sp., *Bradybaena* sp., Cecidomyiidae, Coccidae, *Dasineura* sp., *Dialeurodes* sp., Diaspididae, *Diatrypella* sp., *Erysiphe* sp., *Kleidocerys* sp., *Leptosphaeria* sp., *Microsphaeropsis* sp., *Pestalotiopsis* sp., Phlaeothripidae, *Phoma* sp., *Phomopsis* sp., Pseudococcidae, *Phyllophaga* sp., *Rhizoecus* sp., Scolytidae, Siricidae, Sminthuridae, *Succinea* sp., and *Tarsonemus* sp. Stakeholder comments suggested that even if USDA did not have information about specific quarantine species, it should assume that they exist. That approach (specifically, assuming there are hazards without evidence to identify these hazards) is not consistent with international guidelines or agreements. It is reasonable, however, to assume that the biologies of congeneric organisms are similar and can be related to organisms that are analyzed. And that in addressing these unknowns with specific, applicable mitigations that target biologically similar groups (similar in a phytosanitary-relevant sense) similar treatments and controls will apply. For example, the analysis of the nematodes *T. crassicaudatus*, *T. leviterminalis* and *X. brasiliense* reasonably encompasses the concerns posed by other, incompletely identified nematodes such as: *Aphelenchus* sp., *Paratrophurus* sp., *Criconemella* sp., Dorylaimidae sp., *Dorylaimus* sp., *Helicotylenchus* sp., *Hirschmanniella* sp., *Meloidogyne* sp., *Pratylenchus* sp., *Trichodorus* sp., *Tylenchorhynchus* sp., *Tylenchus* sp., and *Xiphinema* sp. In this risk assessment, *Leptosphaeria* is analyzed to represent fungi such as *Diatrypella*, *Microsphaeropsis*, *Pestalotiopsis*, *Phoma*, and *Phomopsis* spp. These taxonomically diverse fungi are likely to be susceptible to similar control measures and generally occupy similar niches.

Many of the pests in Table 3 identified only to the order, family or generic level are based on PPQ interceptions (*Ascochyta* sp., Aphididae, *Autosticha* sp., *Bradybaena* sp., Cecidomyiidae, *Dasineura* sp., *Dialeurodes* sp., *Diatrypella* sp., *Kleidocerys* sp., *Leptosphaeria* sp., *Pestalotiopsis* sp., Phlaeothripidae, *Phomopsis* sp., *Rhizoecus* sp., Scolytidae, Siricidae, Sminthuridae, *Succinea* sp. and *Tarsonemus* sp.). Often the pest could not be completely identified because the intercepted life stage lacks structures that allow identification to species. Lack of species identification may indicate the limits of the current taxonomic knowledge or the life stage or the quality of the specimen submitted for identification. Even if they could be identified, these pests may or may not belong to quarantine pest species. The intercepted pests identified only to higher taxa may actually belong to a non-quarantine

species, *e.g.*, *Dialeurodes* includes non-quarantine pests like *D. citri* (Ashmead) or *D. citrifolii* (Morgan).

The single interception of Scolytidae on *Sageretia* in 2000 (PIN 309, 2003) was only one of the considerations leading to subsequent rule changes (67 Fed. Reg. 53727-53731). Unlike elm bark beetles which vector disease (Schumann, 1991), and the scolytid beetles on oaks demonstrated not to vector disease (Wertz *et al.*, 1971), there is no evidence on relationships between Scolytid beetles and *Sageretia*. As this plant ages, bark is shed naturally (Caine, 2003). This may provide temporary hiding places for biological contaminants in a shipment, but cannot reasonably be used to infer that a vector and pathogen relationship exists without specific evidence.

The quarantine pests likely to follow the pathway of importation of *S. thea* from China are summarized in Table 4.

Table 4. Quarantine Pests Likely to Follow Pathway on <i>Sageretia thea</i> from China	
ARTHROPODA Homoptera <i>Rhizococcus hibisci</i> Kawai & Takagi (Pseudococcidae) Thysanoptera <i>Thrips palmi</i> Karny (Thripidae)	NEMATODA <i>Xiphinema brasiliense</i> Lordello (Xiphinematidae) <i>Tylenchorhynchus crassicaudatus</i> Williams (Belonolaimidae) <i>Tylenchorhynchus leviterminalis</i> Siddiqi, Mukherjee & Dasgupta (Belonolaimidae)
MOLLUSCA <i>Acusta ravidia</i> (Benson) <i>Succinea horticola</i> Reinhart (Succineidae)	FUNGI <i>Aecidium sageretiae</i> P. Henn. (Basidiomycetes, Uredinales) <i>Leptosphaeria</i> sp. (Loculoascomycetes, Dothideales)

E. Analysis of Quarantine Pests

The undesirable consequences that may occur from the introduction of quarantine pests are assessed in this section. For each quarantine pest, the Pest Risk Potential is calculated by summing the values for the Consequences of Introduction and the Likelihood of Introduction.

The major sources of uncertainty present in this risk assessment are similar to those in other risk assessments. They include the approach used to combine risk elements (Bier, 1999; Morgan and Henrion, 1990), and the evaluation of risk by comparisons to lists of factors within the guidelines (Kaplan, 1992). To address this last source of uncertainty, the lists of factors were interpreted as illustrative and not exhaustive. This implies that additional biological information, even if not explicitly part of the criteria, can be used when it informs a rating. Sources of uncertainty in this analysis stem from the quality of the available biological information (Gallegos and Bonano, 1993), and the inherent, natural biological variation within a population of organisms (Morgan and Henrion, 1990).

1. Consequences of Introduction

This portion of the analysis considers negative outcomes that may occur when the quarantine pests identified as following the pathway of *S. thea* penjing plants from China are introduced into the United

States. The potential consequences are evaluated using the following five Risk Elements: Climate-Host Interaction, Host Range, Dispersal Potential, Economic Impact, and Environmental Impact. These risk elements reflect the biology, host range and climatic and geographic distribution of each pest, and are supported by biological information on each of the analyzed pests. For each risk element, pests are assigned a rating of Low (1 point), Medium (2 points), or High (3 points) based on the criteria as stated in the Guidelines (APHIS, 2000). The summation of the points for each risk rating is the cumulative value for the Consequences of Introduction (Table 5). A cumulative value of 5 to 8 points is considered Low risk for the Consequences of Introduction, 9 to 12 points is Medium, and 13 to 15 points is considered High (APHIS, 2000).

Risk Element 1: Climate/Host Interaction

This risk element considers ecological zonation and the interactions of quarantine pests with their biotic and abiotic environments. When introduced into new areas, pests are expected to behave as they do in their native areas if the potential host plants and suitable climate are present. Broad availability of suitable climates and a wide distribution of suitable hosts are assumed to increase the impact of a pest introduction. The ratings for this risk element are based on the relative number of United States Plant Hardiness Zones (USDA, 1960) with potential host plants and suitable climate.

The variety of climatological regions in China corresponds to many of the climatological regions in the United States because they are at similar latitudes and range from coastal to mountainous regions (Hou, 1983). Penjing plants of *Sageretia* are expected to be grown indoors throughout the country and may be placed outside during favorable weather (Bonsai Brasil, 1999; Caine, 2003; PGBC, 1997). The reported range for outdoor *Sageretia* (Caine, 2003; NatureServe, 2003; NRCS, 2003) includes US Plant Hardiness Zones 8 to 11 (USDA, 1960). The risk rating of High (3) is given for each of the pests for the Climate-Host Interaction Risk Element except for *Thrips palmi*.

Generally, *Thrips palmi* is subtropical to tropical in distribution, but populations in temperate climates overwinter in greenhouses and interiorscapes (CPC, 2002). It cannot survive subzero temperatures for more than a few days (Lewis, 1997). This species occurs in Asia, parts of the tropical Pacific, Africa, Australia, Japan, and South America and European greenhouses (CPC, 2002; Lewis, 1997). The U.S. populations are limited to Hawaii, southern Florida, Guam, Puerto Rico and American Samoa. These areas correspond to Plant Hardiness Zones 9-11 and under field conditions its distribution is likely to be limited to tropical areas (Capinera, 2000) or areas with mild winters (Tsai *et al.*, 1995). For these reasons, the Climate/Host Interaction for this pest is Medium (2).

Risk Element 2: Host Range

The risk posed by a plant pest depends on both its ability to establish a viable, reproductive population and its potential for causing plant damage. This risk element assumes that the consequences of pest introduction are positively correlated with the pest's host range. Aggressiveness, virulence and pathogenicity also may be factors. The consequences are rated as a function of host range and consider whether the pest can attack a single species or multiple species within a single genus, a single plant family,

or multiple families. The large number of hosts, in multiple plant families, attacked by these pests warrants a risk rating for Host Range of High (3) for all of the pests unless otherwise noted.

Rhizoecus hibisci feeds on: *Buxus*, *Calibanus*, *Carex*, *Chusquea*, *Crinum*, *Cryptanthus*, *Cuphea*, *Dichorisandra*, *Dieffenbachia*, *Dioscorea*, *Hakonechloa*, *Hibiscus*, *Nerium*, *Pelargonium*, *Phoenix*, *Rhaphis*, *Sabal*, *Sageretia*, *Serissa*, *Zelkova*, and *Zingiber* (CPC, 2002).

Thrips palmi is reported on many members of the Cucurbitaceae, Fabaceae, and Solanaceae (CPC, 2002; Capinera, 2000; Nakahara, 1994). The host range also includes the following ornamental plants in other plant families: *Chrysanthemum*, *Cyclamen*, *Dahlia*, *Dianthus* and “various orchids” (Nakahara, 1994).

Snails (*A. ravida* and *S. horticola*) feed on foliage, flowers and fruit from various plant species, especially in greenhouses (Godan, 1983; Robinson, 2003), so identifying specific hosts is likely to underestimate the full range of plants that they can feed on. As an example of this diversity, a listing of plants intercepted with *S. horticola* from China includes: *Buxus*, *Carmona*, *Chamaedorea*, *Dracaena*, *Pinus*, *Serissa* and *Zelkova* (PIN 309, 2003).

The host range for *Aecidium sageretiae* appears to be limited to *Sageretia* (China, 1994; Tai, 1979) so the host range rating is Low (1). There are no US rust fungi reported to infect species of *Sageretia* (Arthur, 1962).

The host range rating for *Leptosphaeria* is High (3) because without knowing the specific species, we must assume that there is a risk that a novel species will be able to infect multiple species among multiple plant families should it enter and establish within the United States.

The host range for the stunt nematode *Tylenchorhynchus crassicaudatus* includes *Musa* (Zhang *et al.*, 1995), *Oryza* (Lin and Chiu, 1971), *Saccharum* (Williams, 1960), and *Sorghum* (Rodriguez and Ayala, 1977). The hosts for *T. leviterminalis* include: *Canarium* (Zhang *et al.*, 2002), *Dimocarpus* (Liu and Zhang, 1999), *Rosa* (Pathak and Siddiqui, 1997), *Lycopersicon* (Campos and Sturhan, 1987), *Musa* (Campos *et al.*, 1987; Zhang *et al.*, 1995), *Oryza* (Campos *et al.*, 1987), and *Saccharum* (Talavera *et al.*, 2002).

The host range for *X. brasiliense*, include *Carica*, *Cocos*, *Piper*, *Podocarpus* (Arias *et al.*, 1995), *Citrus* (Crozzoli *et al.*, 1998), *Croton* (Zem, 1977), *Nicotiana*, *Mangifera*, *Theobroma* (CPC, 2002), *Prunus* and *Vitis* (Maximiniano *et al.*, 1998), and *Solanum* (Charchar, 1997).

Risk Element 3: Dispersal Potential

Pests may disperse after introduction into new areas. The dispersal potential indicates how rapidly and widely the pest's impact may be expressed within the importing country or region and is related to the pest's reproductive potential, inherent mobility, and external dispersal facilitation modes. Factors for

rating the dispersal potential include: the presence of multiple generations per year or growing season, the relative number of offspring or propagules per generation, any inherent capabilities for rapid movement, the presence of natural barriers or enemies, and dissemination enhanced by wind, water, vectors, or human assistance. In the United States, plants within the genus *Sageretia* may be grown outdoors (NRCS, 2003). The possibility of mobile pests migrating to outdoor native host plants, particularly during transport, cannot be precluded.

Rhizoecus hibisci is associated with soil and the roots of plants (McKenzie, 1967; Hata *et al.*, 1996; Kosztarab, 1996). Adults and nymphs may crawl out of pot drainage holes or be dispersed in drained water into other pots in a greenhouse (Hata *et al.*, 1996; McKenzie, 1967) so local dispersal within a greenhouse can occur and long-distance transport occurs as plants are traded in commerce (EPPO, 1996a; Hata *et al.*, 1996). The dispersal potential risk rating is Medium (2).

The fecundity of *Thrips palmi* ranges from 3 to 205 eggs per female (CPC, 2002). Dispersal of adults is susceptible to wind and weather because of their small size (Martin and Mau, 1992). Thrips, in general, are believed to alternate between active wing beating in warmer temperatures and passive descent in cooler temperatures during long-distance flight (Lewis, 1997). *Thrips palmi* moves in commodities in international trade as evidenced by the high number of interceptions, particularly in cut flowers (PIN 309, 2003). This pest exhibits high reproductive potential and dispersal capability so it is rated High (3).

Snails are spread in commerce, and due to their hermaphroditism, one organism can start a population (Anon., 2003; Barker, 2002; Godan, 1983). *Acusta ravida* may lay over 600 eggs/season and is increasingly widespread, in China, because modern agricultural practices provide favorable habitats (Barker, 2002). *Succinea horticola* Reinhart, the most important species of its family, is a very severe pest of greenhouse plants and grasses (AFPMB, 1993). It is found in China, Japan, Okinawa, Greece and Italy (AFPMB, 1993). Although this species is not listed as a traveling species, succineids are difficult to identify to the species level (Robinson, 1999). Currently, snail infestations are of heightened concern to APHIS-PPQ because of increase in volume of transported materials and the establishment of the Channeled apple snail, *Pomacea caniculata* (Lamarck) in California and Texas (Robinson, 1999; Smith and Fowler, 2002). The dispersal potential risk rating is High (3).

Members of the genus *Leptosphaeria* discharge spores from fruiting structures, which are then dispersed by wind and rain (Agrios, 1997; Pirone, 1978). So properly watered infected indoor plants are unlikely to widely disperse spores to outdoor plants, and the risk rating is Medium (2). Like other rust fungi, teliospores of *A. sageretiae* will be wind dispersed (Agrios, 1997; Arthur, 1962) so the risk rating is High (3).

The nematodes of concern, *Tylenchorhynchus crassicaudatus*, *T. leviterminalis* and *X. brasiliense*, are all migratory parasites so short-distance or local dispersal will occur when infested potted plants are placed in contact with soil (Agrios, 1997; Jones and Benson, 2001; Sikora, 1992). Long distance dispersal will occur through commerce. The natural dispersal potential risk rating is Low (1).

Risk Element 4: Economic Impact

Introduced pests cause a variety of direct and indirect economic impacts, such as reduced yield, reduced commodity value, loss of foreign or domestic markets, and non-crop impacts. Factors considered during the ranking process included whether the pest would: effect yield or commodity quality, cause plant mortality, act as a disease vector, increase costs of production including pest control costs, lower market prices, effect market availability, increase research or extension costs, or reduce recreational land use or aesthetic value.

In the greenhouse, *Rhizoecus hibisci* is a pest of ornamentals that can cause serious damage to roots (Kawai and Takagi, 1971) but it does not appear to be damaging outside of greenhouses in Hawaii (Hata *et al.*, 1996) so the rating is Medium (2).

Thrips palmi severely damages vegetable crops, and is a vector of tomato spotted wilt tospovirus (CPC, 2002; Tsai *et al.*, 1995). Extensive feeding by larvae and adults on leaves, stems, flowers and fruit produce scarring and deformities (Martin and Mau, 1992). Terminal growth of these crops becomes stunted, discolored and deformed (Capinera, 2000), and leaves of heavily infested plants appear silvered or bronzed (Martin and Mau, 1992). The extent of damage caused to penjing plants appears to be low because *T. palmi* is a primary pest of Cucurbitaceae, Fabaceae, and Solanaceae (CPC, 2002; Capinera, 2000; Nakahara, 1994). Control programs relying on ultra-violet reflective sheets in greenhouses may be effective in reducing populations (Lewis, 1997), but to date, overall market effects of these measures have not been examined. For these reasons, the rating for economic impact is High (3).

Feeding by *A. ravidia* can defoliate major crops such as cotton, cabbages and legumes, and yield losses up to 25 percent occurred in China (Barker, 2002). Mollusk feeding also reduces the visual quality of the plant, the available photosynthetic surface area, and some mollusks clip succulent plant parts (Godan, 1983; Ohlendorf, 1999; Lai, 1984). Deep plowing and the application of chemicals, in combination with hoeing and raking to expose eggs, is necessary for good control of *A. ravidia* (Barker, 2002). It is anticipated that if *A. ravidia* or *S. horticola* are introduced into the United States, there will be a need for similar control measures, so the rating is High (3).

The fungus *Aecidium sageretiae* is a member of a rust genus that can defoliate and retard the growth of host plants, and high levels of infection can kill plants (Agrios, 1997; Arthur, 1962; Van der Plank, 1963). Leaf-spots caused by fungal pathogens reduce the market value of plants when observed by potential buyers (Agrios, 1997; Pirone, 1978). Most leaf-spot causing pathogens reduce visual quality, available photosynthetic area, and plant vigor (Agrios, 1997; Jarvis, 1992; Kahn and Mathur, 1999; Pirone, 1978). While infections by stem infecting fungi such as *Leptosphaeria* may create the impression of old age, they can ultimately kill hosts, but because environmental conditions needed for infection do not continually

occur (Agrios, 1997; Pirone, 1978; Van der Plank, 1963) it is less likely that outdoor landscape plants will be killed. The risk rating for the fungi is Medium (2).

Nematode infestations are cryptic and unlikely to be observed except as reduced plant vigor. Although local dispersal may lead to permanent infestations within a greenhouse or nursery (Agrios, 1997; Jones and Benson, 2001), minimal long-distance dispersal affecting all potential hosts is expected unless infected *Sageretia* are used as landscape ornamentals and alternative hosts are nearby. Even if this occurs, minimal economic impact is likely for several reasons. First, many of the hosts are not grown throughout the continental United States, *e.g.* *Saccharum*, *Citrus*. Second, organic mulches and green manure may be antagonistic to nematode populations (Sikora, 1992). Third, the pantropical *X. brasiliense* (Luc and Coomans, 1992) is associated with native forest flora (Fortuner and Couturier, 1983). For these reasons, the economic impact rating for *Tylenchorhynchus crassicaudatus*, *T. leviterminalis* and *X. brasiliense* is Low (1).

Risk Element 5: Environmental Impact

The ratings for this risk element are based on three aspects; potential to disrupt native plants based on the pest's habits exhibited within its current geographic range; the potential that the presence of the pest will stimulate the need for additional chemical or biological control programs; the potential to the pest to directly or indirectly impact species listed as Threatened or Endangered (50 CFR ' 17.11-12) by infesting or infecting a listed plant that is in the same genus as its hosts. When a pest is known to infest or infect other species within the same genus, and feeding preference data does not exist with the listed plant, then the listed plant is assumed to be a potential host. The insect pests exhibit wide host ranges in China, but the most likely effect of many of these pests is to reduce vigor although young plants can be killed (Agrios, 1997; Carter, 1984; Borror *et al.*, 1989; Hill, 1987).

Potential hosts for *R. hibisci* could include: the Endangered species of *Buxus vahlii* found in Puerto Rico and the Virgin Islands; the Endangered *Carex albida* and *C. lutea* in California and North Carolina, respectively; the Threatened *C. specuicola* in Arizona and Utah; the Endangered *Hibiscus arnottianus* ssp. *immaculatus*, *H. brackenridgei*, *H. clayi*, and *H. waimeae* ssp. *hannerae* in Hawaii; and the Candidate *H. dasycalyx* in Texas (NatureServe, 2003). Potential hosts for *T. leviterminalis* could include the Endangered *Euphorbia haeleeleana* in Hawaii and the Threatened *E. telephioides* in Florida (NatureServe, 2003). Potential hosts for *X. brasiliense* include the Endangered *Prunus geniculata* in Florida, and the Endangered species *Solanum drymophilum* in Puerto Rico, *S. incompletum* and *S. sandwicense* in Hawaii, and the Candidate *S. nelsonii* in Hawaii (NatureServe, 2003). The environmental risk rating for *R. hibisci*, *T. leviterminalis*, and *X. brasiliense* is High (3). The environmental risk rating is High (3) for the snails because all listed plant species are at-risk from these non-host specific organisms.

Potential hosts for *Thrips palmi* could include the Endangered species *Allium munzii* located in California; *Cucurbita okechobeensis* ssp. *okechobeensis* and *Prunus geniculata* in Florida; *Helianthus schweinitzii* in North and South Carolina; *Vigna o-wahuensis* in Hawaii; *Solanum*

dryophilum in Puerto Rico; and *S. incompletum* and *S. sandwicense* in Hawaii (NatureServe, 2003).

Additional potential hosts for *T. palmi* could also include the Threatened species of *H. eggertii* in Alabama, Kentucky, and Tennessee and *H. paradoxus* in New Mexico and Texas, as well as the Candidate species *S. nelsonii* in Hawaii and *H. verticillatus* in Alabama, Georgia, and Tennessee (NatureServe, 2003). The following genera of hosts (Capinera, 2000; CPC, 2002; Nakahara, 1994) for *Thrips palmi* do not have species listed as Endangered, Threatened or Candidates for listing (USFWS, 2003): *Capsicum*, *Chrysanthemum*, *Citrus*, *Cucumis*, *Cyclamen*, *Dahlia*, *Dianthus*, *Glycine*, *Gossypium*, *Ipomoea*, *Lactuca*, *Lycopersicon*, *Mangifera*, *Nicotiana*, *Oryza*, *Persea*, *Phaseolus*, and *Sesamum*. Resistance to oxamyl and organophosphates is reported, and while methiocarb was effective in one study, it is not registered for use on vegetable crops in the United States (Martin and Mau, 1992). The environmental risk rating for *Thrips palmi* is High (3).

For the fungus *Aecidium sageretiae* and the nematode, *Tylenchorhynchus crassicaudatus*, there are no hosts that are in the same genera as species listed as Threatened, Endangered or proposed (Candidate) species for listing (USFWS, 2002). The risk rating for these two pests is Low (1) because of the low prevalence of *Sageretia* in U.S. native ecosystems, the pests narrow host ranges, and because existing mitigation measures used against other pests are likely to provide adequate control. Stem infecting fungi are likely to reduce aesthetic quality and may ultimately kill penjing plants, but because environmental conditions needed for infection do not continually occur and infected stems are likely to be pruned before spores become widely dispersed (Agrios, 1997; Pirone, 1978; Van der Plank, 1963) particularly into outdoor habitats, it appears unlikely that a novel species of *Leptosphaeria* will disrupt native plants, ecosystems, or create a need for control programs. So the risk rating is Low (1).

Table 5. Risk Ratings for the Consequences of Introduction ¹ .						
Pest	Climate / Host	Host Range	Dispersal Potential	Economic Impact	Environmental Impact	Consequences of Introduction
<i>Rhizoeus hibisci</i>	High (3)	High (3)	Medium (2)	Medium (2)	High (3)	High (13)
<i>Thrips palmi</i>	Medium (2)	High (3)	High (3)	High (3)	High (3)	High (14)
<i>Acusta ravidia</i> <i>Succinea horticola</i>	High (3)	High (3)	High (3)	High (3)	High (3)	High (15)
<i>Aecidium sageretiae</i> <i>Leptosphaeria</i> sp.	High (3)	Low (1) High (3)	High (3) Medium (2)	Medium (2)	Low (1)	Medium (10) Medium (11)
<i>Tylenchorhynchus crassicaudatus</i> <i>T. leviterminalis</i> <i>Xiphinema brasiliense</i>	High (3)	High (3)	Low (1)	Low (1)	Medium (2) High (3) High (3)	Medium (10) Medium (11) Medium (11)

¹ Individual ratings are presented when there is variability within a risk element, otherwise a single rating applies to all the pest organisms within that taxa for that risk element.

Likelihood of Introduction

The Likelihood of Introduction for a pest is rated relative to six factors (APHIS, 2000). The assessment rates five of these areas based on the biological features exhibited by the pest's interaction with the commodity. These areas represent a series of independent events that must all take place before a pest outbreak occurs. These five areas are: the availability of post-harvest treatments, whether the pest can survive through the interval of normal shipping procedures, whether the pest can be detected during a port of entry inspection, the likelihood that the pest will be imported or subsequently moved into a suitable environment, and the likelihood that the pest will come into contact with suitable hosts. The value for the Likelihood of Introduction is the sum of the ratings for the Quantity Imported Annually and these biologically based areas (Table 6). The following scale is used to interpret this total: Low is 6-9 points, Medium is 10-14 points and High is 15-18 points.

Risk Element 6, subelement 1: Quantity Imported Annually

The rating for this risk element is based on the amount reported by the country of proposed export converted into standard units of 40-foot long shipping containers (APHIS, 2000; Cargo Systems, 2001). The quantity of *S. thea* to be shipped annually from China is projected to fill ten to one-hundred 40-foot shipping containers. Permission to import into the United States may be linked with an increase in production in the future. For this reason, this element is rated as Medium (2).

Risk Element 6, subelement 2: Survive Postharvest Treatment

Whole trees are not likely to receive postharvest treatments such as irradiation, methyl bromide, or steam sterilization because there is no harvest of the commodity, and the types of treatments that would kill pests are also likely to kill the trees. Like other post-harvest treatments, the presence of artificial media and/or pots requires specific testing to ensure the efficacy of any proposed post-harvest treatments (Paull and Armstrong, 1994). For these reasons, all of the pests are rated High (3).

Risk Element 6, subelement 3: Survive Shipment

This sub-element evaluates the mortality of the pest population during shipment of the commodity. Shipments of *S. thea* are not likely to be refrigerated and may spend two to four weeks in maritime transit to the United States (Cargo Systems, 2001; AQIM, 2002). Direct air shipments will not take this long. Interceptions by PPQ of the various pests (on any host) is evidence that when these pests are present on transported plants (in passenger baggage, permit cargo, general cargo, ships stores, etc.) that they can survive the ambient transport conditions (PIN 309, 2003). The rating for all of the pests is High (3).

Risk Element 6, subelement 4: Not Detected at Port of Entry

In general, careful inspection for the mobile life stages of insect pests can detect them despite their small size (Rosen, 1990). The very high number of interceptions of these pests from any country and on any commodity confirms that trained inspectors can find insect pests in shipments (PIN 309, 2003). The mealybug, *R. hibisci*, feeds on the roots of its host (Williams, 1996). If present, the microscopic nematodes (*T. crassicaudatus*, *T. leviterminalis* and *X. brasiliense*) will swim in the water associated with the roots of the plants (Agrois, 1997) and remain undetected. The snails *A. ravida* and *S. horticola* are likely to be detected only if slime trails are present, but eggs and populations resident in the growing

medium are likely to evade detection without destructive sampling (Burch, 1962; Godan, 1983; Lai, 1984). For these reasons, all of these pests are rated High (3) because they are unlikely to be detected during a port of entry inspection.

Large infestations of *Thrips palmi* are likely to be detected by the leaf symptoms (Martin and Mau, 1992), but small life stages, limited populations, or soil-borne life stages are likely to evade detection (CPC, 2002) so the rating is Medium (2). While stem and leaf spot symptoms are easily detected (Pirone, 1978), latent infections or dormant spores present on the plants will be undetected, so the rating for both fungi is Medium (2). Both of these fungi are in genera where latent periods occur (Agrios, 1997).

Risk Element 6, subelement 5: Imported or Moved To An Area Suitable for Survival

This sub-element considers the geographic location of likely markets and the chance of the commodity moving to locations suitable for the pests survival. Plants for planting that arrive in the United States are distributed according to market demand. The arthropod, mollusks and nematodes are rated Medium (2) because these plants can be used in interiorscapes throughout the country and outdoor locations in the United States can provide suitable habitats for some of these pests.

The warmer habitat preferred by *Thrips palmi* may not be met in exterior situations (Lewis, 1997), so establishment of populations outside of greenhouses and interiorscapes is unlikely for most of the territorial United States (Capinera, 2000; Tsai *et al.*, 1995). The rating for *T. palmi* is Low (1). Fungi often need specific humidity and temperature ranges to infect (Agrios, 1997; Van der Plank, 1963), so while indoor plants may be in highly suitable environments for fungal infection, the chances of fungal spores reaching outdoor suitable habitats are lessened. When the preferred indoor growth of *Sageretia* is considered, the risk rating for the fungi is Medium (2).

Risk Element 6, subelement 6: Contact with Host Material

The presence of suitable hosts provides opportunities for pests to establish populations. The arthropod pest, *R. hibisci*, is rated High (3) because it is likely to establish indoor populations on a wide variety of ornamental plants and subsequently escape outdoors. The mollusks, *A. ravidia* and *S. horticola*, are rated High (3) because they are non-specific feeders (Robinson, 2003).

Lack of suitable hosts restricts the opportunities for pests to establish populations. While passive factors such as wind, water, or animals may aid in the dispersal of stages of the insect pests (Kosztarab and Kozar, 1988; Rosen, 1990), suitable hosts must be available to sustain a pest population over time. Plants grown in indoor residential areas are likely to be widely separated from native host plant populations, but the close proximity of outdoor plant populations to host material provides a pathway for pests to become established (Beardsley and Gonzalez, 1975). The numbers and types of hosts available to the pest, therefore, becomes a limiting factor for pests with a small host range, such as *Aecidium sageretiae*, and are rated Low (1). Based on similar environmental considerations and because of the uncertainty associated with evaluating the risk for an unidentified member of a genus, the fungus *Leptosphaeria* is rated Medium (2).

For *Thrips palmi*, contacting hosts also will require escape from the indoor setting and finding mates. Low population densities tend to produce only male offspring (arrhenotoky) leading to overall population decline (Lewis, 1997) so this pest is rated Low (1). Reduced dispersal capability will limit the contact with host material for the nematodes (*T. crassicaudatus*, *T. leviterminalis* and *X. brasiliense*) because many of their hosts are not typically grown indoors in the United States, so contacting hosts will require escape from the indoor settings. These pests are rated Medium (2).

Table 6. Risk Ratings for the Likelihood of Introduction ¹ .							
Pest	Quantity Imported Annually	Survive postharvest treatment	Survive shipment	Not detected at port of entry	Move to a suitable habitat	Find suitable hosts	Risk Rating
<i>Rhizoeus hibisci</i>	Medium (2)	High (3)	High (3)	High (3)	Medium (2)	High (3)	High (16)
<i>Thrips palmi</i>	Medium (2)	High (3)	High (3)	Medium (2)	Low (1)	Low (1)	Medium (12)
<i>Acusta ravidia</i> <i>Succinea horticola</i>	Medium (2)	High (3)	High (3)	High (3)	Medium (2)	High (3)	High (16)
<i>Aecidium sageretiae</i> <i>Leptosphaeria</i> sp.	Medium (2)	High (3)	High (3)	Medium (2)	Medium (2)	Low (1) Medium (2)	Medium (13) Medium (14)
<i>Tylenchorhynchus crassicaudatus</i> <i>T. leviterminalis</i> <i>Xiphinema brasiliense</i>	Medium (2)	High (3)	High (3)	High (3)	Medium (2)	Medium (2)	High (15)

¹ Individual ratings are presented when there is variability within a risk element, otherwise a single rating applies to all the pest organisms for that risk element.

F. Conclusion: Pest Risk Potential

The summation of the values for the Consequences of Introduction and the Likelihood of Introduction is the value for the Pest Risk Potential (Table 7). The following scale is used to interpret this total: Low is 11-18 points, Medium is 19-26 points and High is 27-33 points. This is an estimate of the risks associated with this importation, and reduction of risk occurs through the use of mitigation measures.

The Pest Risk Potential for all of the arthropod and mollusk pests is High, and the Pest Risk Potential for the fungal and nematode pathogens is Medium. Pests with a Low Pest Risk Potential typically do not require mitigation measures other than port of arrival inspection. Specific phytosanitary measures may be necessary for pests rated Medium, and specific phytosanitary measures are strongly recommended for pests with a High Pest Risk Potential.

Table 7. Consequences of Introduction, the Likelihood of Introduction and the Pest Risk Potential.			
Pest	Consequences of Introduction	Likelihood of Introduction	Pest Risk Potential
<i>Rhizoeus hibisci</i>	High	High	High

Table 7. Consequences of Introduction, the Likelihood of Introduction and the Pest Risk Potential.			
Pest	Consequences of Introduction	Likelihood of Introduction	Pest Risk Potential
	(13)	(16)	(29)
<i>Thrips palmi</i>	High (14)	Medium (12)	Medium (26)
<i>Acusta ravidia</i> <i>Succinea horticola</i>	High (15)	High (16)	High (31)
<i>Aecidium sageretiae</i> <i>Leptosphaeria</i> sp.	Medium (10) Medium (11)	Medium (13) Medium (14)	Medium (23) Medium (25)
<i>Tylenchorhynchus crassicaudatus</i> <i>T. leviterminalis</i> <i>Xiphinema brasiliense</i>	Medium (10) Medium (11) Medium (11)	High (15)	Medium (25) Medium (26) Medium (26)

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